

least one was deposited completely in the bursa, fertile eggs were laid by such a female. The highest number of spermatophores found in a female was three, normally, however, a fertilized female contained only one spermatophore.

Out of the four females each confined with two males at 34°C, none laid any eggs. Mating failed to occur at this temperature and dissection of females after death showed that the ovaries contained only a few degenerate eggs and there was no fat body. Out of the nine females, each kept with two males at 29.8°C, two failed to oviposit and the remaining seven laid only a few infertile eggs. In some of these mating was unsuccessful as seen by the partly everted spermatophore through the female genitalia; in all others, mating failed to occur as revealed by the absence of spermatophores in the bursae of the dead females.

When the earlier stages of the pest were reared at different temperatures and the adults were kept in pairs at an optimum temperature of 22°C with food, all females that developed at 16°C and 22°C laid fertile eggs but those which developed at higher temperatures of 26°C and 29.8°C laid 30% and 66% infertile eggs, respectively.

High temperatures during rearing and particularly during imaginal life have been found to produce sterility and to result in increased percentage of infertile eggs in other Lepidoptera and this has been explained as due to degeneration of eggs and exhaustion of fat bodies in females and retardation of spermatogenesis in males.

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#### 24. STUDIES ON THE BIOLOGY OF *PHYTOMYZA* *ATRICORNIS* MEIGEN (AGROMYZIDAE: DIPTERA)

Taskhir Ahmed & Gupta (1941)<sup>1</sup> have reported *Phytomyza atricornis* Mg. as a polyphagous pest feeding on over 72 species from 13 plant families.

During the first week of December 1966 large number of leaves of the Pea crop were found infested by the leaf miners, *Phytomyza*

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<sup>1</sup>AHMED, T. & GUPTA, R. L. (1941): The Pea leaf miner, *Phytomyza atricornis* (Meigen) in India. *Indian J. Ent.* 3: 37-49.

*atricornis* M., and *Liriomyza brassicae* Riley at the central Research farm, Gwalior. This opportunity was availed of to study the biology of *P. atricornis* in detail.

*Nature and extent of damage:*

The first indication of damage seen on the leaves was numerous punctures made by the female with her ovipositor. These punctures later changed into prominent protuberances. In some cases the intensity of these punctures was so high that the tender leaves in freshly sprouted plants etiolated, while in plants growing in dry areas they withered. The larvae mined the leaves by eating through the mesophyll, leaving the two epidermal layers intact. In case of severe infestation the leaves withered away while flowering and fruiting was considerably reduced.

The intensity of attack was noted on fifty leaves at a time during February and March 1967. The data collected during four observations on the number of punctures and larvae and pupae per leaf revealed that they varied from 12 to 18 and 6 to 8 respectively. Percentage infestation varied from 40 to 74.

*Mating:*

Mating occurred 3 to 5 days after emergence of adults. During copulation the female remained stationery, while the male with its wings closed, sat lightly over the female holding her first abdominal segment with the first pair of legs and the mid-abdomen with the last pair of legs. A single act of copulation took a maximum of 90 minutes and a minimum of 15 minutes.

*Pre-oviposition and oviposition:*

The female made punctures with her ovipositor by tilting her abdomen over the hind legs, turning the abdomen tip downwards, and bringing the ovipositor vertically on to the leaf surface. It then pierced the leaf tissues, stretched the ovipositor obliquely, revolved it under the epidermis by thrusting it repeatedly forming a triangular blotch at the point of entry of ovipositor. The eggs were deposited singly.

From the second week of January to the middle of March, 6 pairs of adults were kept under observation for studying the pre-copulation and oviposition periods and fecundity per female. The pre-copulation period ranged from 3 to 5 days. The female started laying eggs soon after copulation. The oviposition period varied from 3 to 6 days, the maximum being in the fourth week of January. It decreased to 3 days during March due to rise in temperature. The number of eggs per female varied from 87 to 203.

*Incubation period and hatching:*

From about the middle of January to middle of March, 6 batches of 50 eggs were kept under observation and 86 to 94% of them hatched. There seemed to be a slight decrease in hatching as the temperature rose. Similarly the incubation period varied between 3 and 7, increase in the atmospheric temperature decreasing the incubation period. During hatching the chorion was broken at the side by the thrusting movement of the head of the larva inside the egg.

*Larval and pupal periods:*

The larval and pupal periods recorded in 6 cases from third week of January to third week of March varied from 6 to 10 and 5 to 12 days respectively.

*Life cycle and longevity of adults:*

The period required for one life cycle varied from 15 to 28 days. The longevity of male and female varied from 2 to 8 days and 4 to 18 days respectively. The males lived longer when kept with the females.

*Sex ratio:*

On examining 20 laboratory bred specimens in each month from January to March for their sex it was found that in January males and females were equal in number while the males outnumbered the females in February and March.

## STAGES OF GROWTH

*Egg:*

Average of 10 eggs—Length 0.36 mm., breadth 0.15 mm., oval, colourless, somewhat translucent, surface smooth, sensitive to drought as it is laid in leaf tissues.

*Maggot:*

FIRST INSTAR: Average of 10 maggots—Length 1.33 mm., breadth 0.35 mm., Metapneustic, white, smoothly cylindrical tapering at the anterior end. Cephalic region with circular pits (sense organs), pair of antennae and maxillary palpi, mouth hooks each with two teeth. Body eleven-segmented.

SECOND INSTAR: Average of 10 maggots—Length 1.78 mm., breadth 0.58 mm. Amphipneustic, pale yellowish, chitinized ventral plate bearing smoky brown trophic organs.

TABLE I  
LIFE CYCLE PERIOD AND LONGEVITY OF ADULTS *P. atricornis*

Date of egg laying	Date of hatching	Incubation period (in days)	Date of pupation	Larval period (in days)	Date of emergence of adults	Pupal period (in days)	Pre-imaginal period (in days) C <sub>0</sub> · 3+5+7	Date of death	Longevity ♂ ♀
13-i-67	19-i-67	6	29-i-67	10	7-ii-67	9	25	15-ii-67 ♂	8
24-i-67	31-i-67	7	9-ii-67	9	21-ii-67	12	28	25-ii-67 ♀	15
9-ii-67	15-ii-67	6	22-ii-67	7	4-iii-67	10	23	8-iii-67 ♀	5
15-ii-67	20-ii-67	5	28-ii-67	8	7-iii-67	7	20	9-iii-67 ♂	9
8-iii-67	12-iii-67	4	18-iii-67	6	24-iii-67	6	16	13-iii-67 ♂	6
14-iii-67	17-iii-67	3	24-iii-67	7	29-iii-67	5	15	10-iii-67 ♀	4
								13-iii-67 ♂	5
								28-iii-67 ♀	4
								29-iii-67 ♂	5
								31-iii-67 ♂	2
								2-iv-67 ♀	4

THIRD INSTAR: Average of 10 maggots—Length 3.25 mm., breadth 0.90 mm., colour somewhat brown. Enteroventral surface of head divided into two plates, each bearing antennae and maxillary palpi, the latter with ten sensory papillae, terminal three much longer than the rest. Chitinous labial plate light brown.

*Pupa:*

Average of 10 pupae—Length 2.09 mm., breadth 0.9 mm. Long oval and pale yellow when fresh, attains reddish brown or dark brown colour at the time of emergence of adult. Segments well defined, both the anterior and posterior spiracles prominent.

*Adult:*

Average of 10 adults of each sex—Length 3.2 mm. and 2.8 mm., breadth 9.0 mm. and 8.7 mm. of male and female respectively. Inter-orbital space and ventral region of face yellow, two sub-equal superior and one to two inferior orbital setae, third segment of antenna quadrate, slightly longer, colour black. Mesonotum black with a light grey bloom; pleural sutures narrowly yellow; femora, tibiae and tarsi dull black; wings hyaline, halteres yellow.

*Natural enemies:*

During the course of the study a larval eulophid parasite, *Neochrysocharis* sp. and a pupal braconid parasite, *Opius* sp. were recorded. The extent of parasitisation by these parasites were 2 to 84% and 40% respectively.

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25. A NEW HOST OF THE BRINJAL SHOOT AND FRUIT  
BORER *LEUCINODES ORBONALIS* GUEN, AND  
ITS BIOLOGY

*Leucinodes orbonalis* Guen. is generally considered a serious pest of brinjal (*Solanum melongena* L.) in which it bores the shoots and fruits. It has also been recorded attacking many other plants.